Santa Clara Valley Water District

Groundwater Conditions 73·74

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SANTA CLARA VALLEY WATER DISTRICT

ANNUAL SURVEY REPORT
ON
GROUNDWATER CONDITIONS

by

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TABLE OF CONTENTS

Page

Summary 1
Introduction 3
Hydrologic Balance 5
Groundwater levels 9
Land Surface Subsidence 16
Imported Water 18
Water Supply 20
Water Quality 25
Salt Water Contamination 31

LIST OF TABLES

Table 1 Water Use Summary
Santa Clara Valley Groundwater Basin 24

LIST OF FIGURES

Figure 1 Hydrologic Balance of the Groundwater Basins . . . 7
Figure 2 Fluctuations of Average Water Level 10
Figure 3 Rainfall, Depth to Water, Land Subsidence,
and Population in North Santa Clara County 12
Figure 4 Rainfall, Depth to Water and Population in
Llagas Groundwater Basin 14
Figure 5 Accumulated Annual Departure in Inches From
the 100-Year Average Rainfall @ San Jose 22
Figure 6 Projected Water Demand and Actual Water Production 23
Figure 7 Temporal Variation of Nitrates and TDS
Llagas Basin 28
Figure 8 Temporal Variation of TDS and Chloride -
North County 29
Figure 9 Temporal Variation of TDS - North County 30

LIST OF PLATES

Plate 1 Groundwater Basins and Water Zones 33
Plate 2 Lines of Equal Groundwater Elevation as
Measured in Wells, September 1974. 34
Plate 3 Lines of Equal Change in Elevation of Water in
Wells from June 1, 1973 to June 1, 1974 35
Plate 4 Lines of Equal Depths to Water As
Measured in Wells, September 1, 1974 36
Plate 5 100 PPM Chloride Line 37

SUMMARY OF 1973-74
GROUNDWATER CONDITIONS

Groundwater levels continued to rise in Santa Clara County for the water year July 1, 1973 through June 30, 1974. With just above-average rainfall, 1973-74 ended showing increases of groundwater in storage of 44,000 acre-feet in the Santa Clara Valley Groundwater Basin, 1000 acre-feet in the Coyote Groundwater Basin, and 9000 acre-feet in the Llagas Groundwater Basin.

During this same period, the District imported 86,565 acre-feet of water through the South Bay Aqueduct. The Rinconada Water Treatment Plant treated 45,471 acre-feet of this water and most of the remaining 41,094 acre-feet was diverted to District facilities for groundwater recharge. The District's new Penitencia Water Treatment Plant went on line in July 1974. The 20-mgd plant will be supplying treated water to the eastside of Santa Clara Valley. The District has requested 100,000 acre-feet from the State for the 1975 calendar year.

No further land subsidence was detected in 1973-74. Subsidence has been effectively halted since 1969 due to the continued rise of groundwater levels.

Groundwater continues to be high-quality water usable for all beneficial purposes. However, certain localized areas have yielded groundwater inferior in mineral quality. Inspection of groundwater chloride-concentration data indicates that the limits of saltwater contamination in most places have not changed significantly during the period 1949 through 1972. To reduce intrusion and protect the aquifers the District is designing a water reclamation facility in Palo Alto which will inject reclaimed water into the shallow aquifers, creating a freshwater barrier. The reclamation program will be monitored to gather information on the public health aspects associated with the use of reclaimed water.

INTRODUCTION

This is the annual report on groundwater conditions in the three major groundwater basins of Santa Clara County for water year 1973-74 which extends from July 1, 1973 to June 30, 1974. The purpose of this report is to inform the District Board of Directors and interested citizens of the current condition of our groundwater basins. The three major groundwater basins, which are interconnected and occupy nearly 30 percent of the total county area, are the Santa Clara Valley, Coyote and Llagas Basins, shown on Plate 1. Groundwater supplies nearly 55 percent of the total water used in the Santa Clara Valley Basin and nearly all of that used in the Coyote and Llagas Basins.

Zones of benefit have been established for the conservation, importation, treatment and distribution of water used in Santa Clara County and are shown on Plate 1.

Zone W-2 encompasses the Santa Clara Valley Groundwater Basin and was formed for the registration of those groundwater producing facilities that benefit from recharge of the groundwater basin by the District with local and imported water. In this zone, a charge is levied for groundwater extracted and the revenue thus derived is used to support the District's conservation and importation program. Major sources of water supply income are the groundwater charge levied in Zone W-2 and the sale of treated water. The groundwater charge for nonagricultural uses is $30 an acre-foot, and for agricultural uses the groundwater charge is $8 an acre-foot. Treated water is sold at $65 an acre-foot, with water in excess of contracted amounts sold at $38 an acre-foot.

Zone W-4 encompasses all of Zone W-2 plus the lands of water consumers outside of Zone W-2 that use or otherwise benefit from locally conserved water and from the importation and distribution of water from the South Bay Aqueduct. In this zone, a property tax rate of $.017 per $100 of assessed valuation is levied to pay for the cost of water purchased to recover the accumulated overdraft in the groundwater basin, control land subsidence, and sustain an emergency supply of water.

In Zone W-3, comprising most of the Coyote Basin, an ad valorem tax of $.370 per $100 of assessed value (on land only) is levied in lieu of a groundwater charge. The three subzones within Zone W-3 were formed for the purpose of assessing a groundwater charge on pumping facilities that export water from the Coyote Groundwater Basin to areas outside of Zone W-3. No groundwater charge was levied in the Llagas Basin.

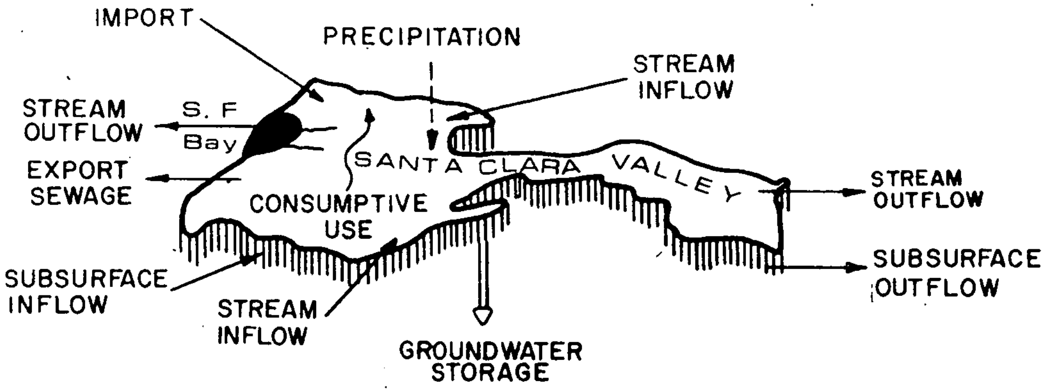
HYDROLOGIC BALANCE

Rainfall was slightly above average for the Santa Clara Valley in 1973-74, being 114 percent of normal at San Jose and 119 percent at Gilroy. All the District's conservation reservoirs were filled to capacity by April 1, 1974 including Anderson, which was last full in 1969. The three groundwater basins each experienced increases in the volume of water in storage.

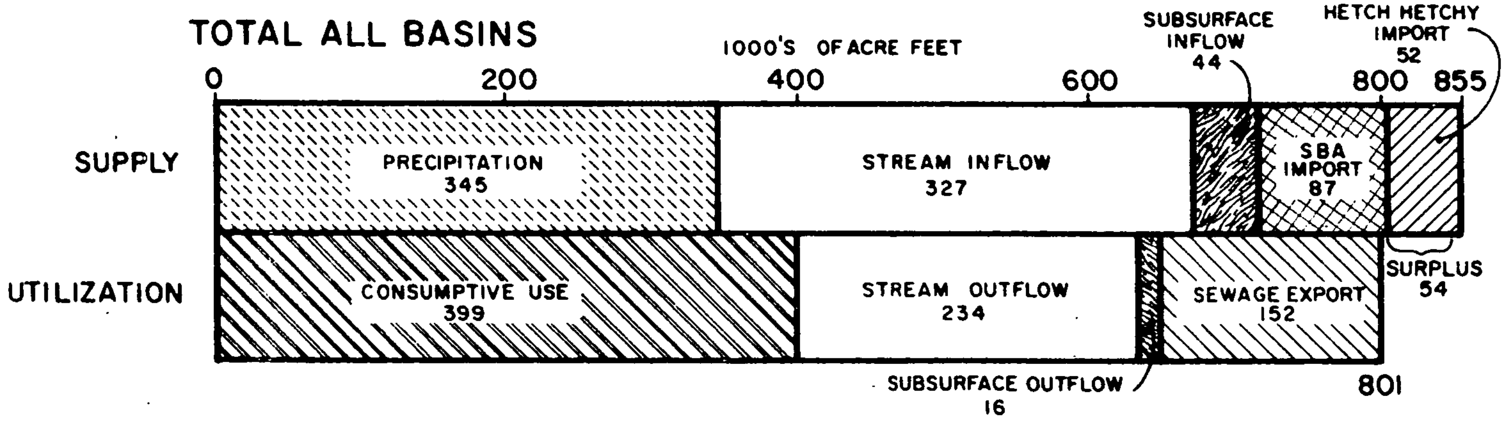
The volume of water in storage changes as water levels rise and fall. In a groundwater basin, this change of stored water, in the unconfined zone, can be computed by multiplying estimates of the storage capacity for the aquifer materials by the area and by the change in depth between groundwater levels at the beginning and end of the season (Plate 3). This year increases of 38,000 acre-feet in the Santa Clara Valley Basin, 2000 acre-feet in the Coyote Basin and 6000 acre-feet in the Llagas Basin were computed.

These estimates were checked by balancing the hydrologic components of water supply and utilization. Water supply consists of precipitation, stream inflow, imported water and subsurface inflow. Water is utilized or lost by consumptive use, sewage export, stream outflow and subsurface outflow. The difference between supply and utilization is the net surplus or deficit of water in storage in the groundwater reservoirs at the end of the season. The hydrologic balance, illustrated in Figure 1, shows that the increase in the Santa Clara Valley Basin was 44,000 acre-feet, the increase in the Coyote Basin was 1,000 acre-feet, the increase in the Llagas Basin was 9,000 acre-feet, (these compare favorably to the previously obtained surpluses of 38,000; 2,000 and 6,000 acre-feet, respectively).

The discrepancy observed between the storage changes obtained as a net balance of hydrologic components and that obtained as a product of change in water levels and storage capacity is the result of uncertainties involved in the estimation of subsurface inflows, consumptive use and the storage coefficient of aquifers. However, the results are well within the accuracy acceptable for this kind of computation.



SCHEMATIC HYDROLOGIC BALANCE



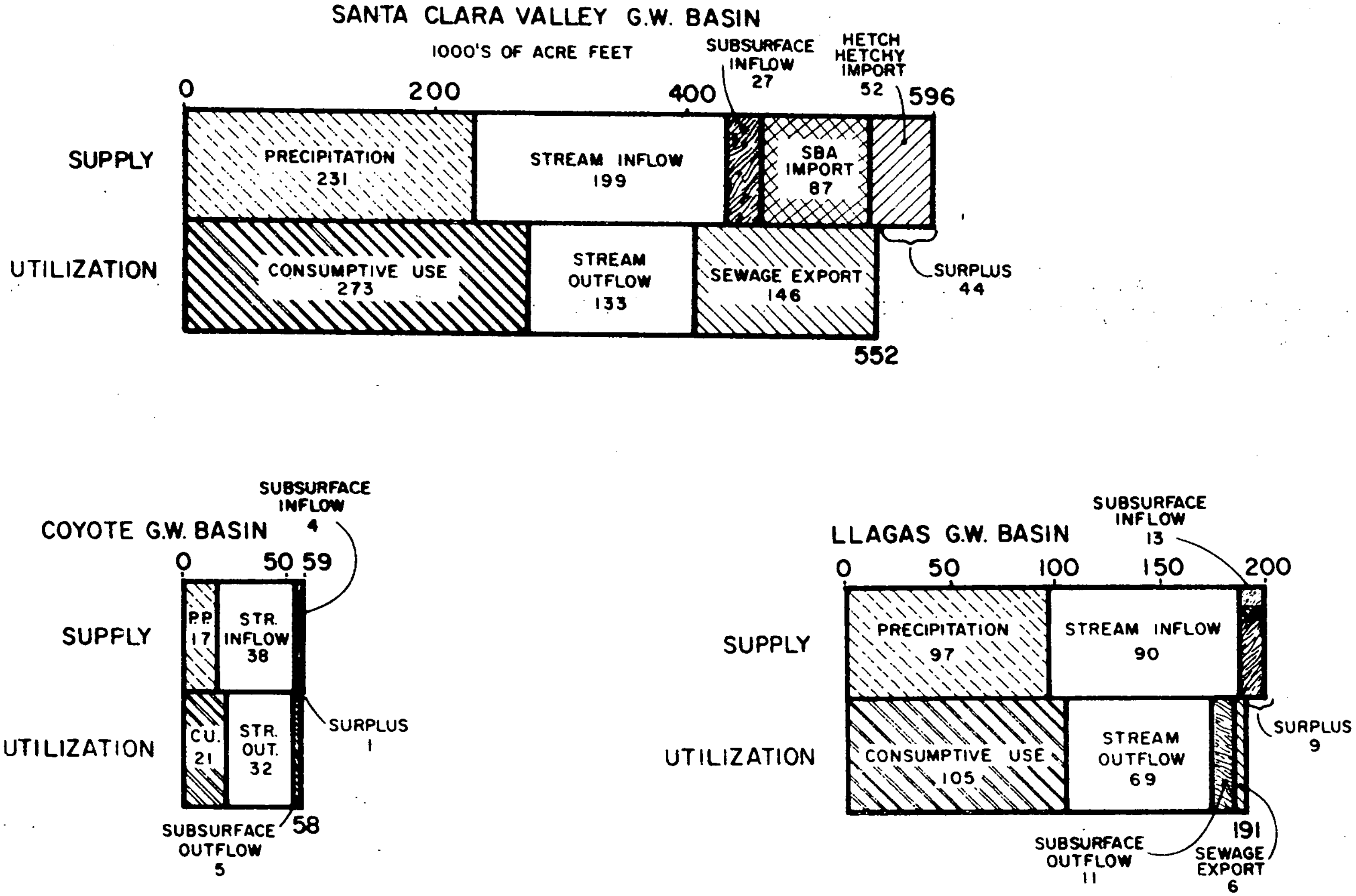


FIGURE I. HYDROLOGIC BALANCE OF GROUNDWATER 1973-74
(VALUES IN 1000'S ACRE FEET)

GROUNDWATER LEVELS

A groundwater contour map, showing lines of equal elevation of water levels in wells as of September 1, 1974 (traditionally the seasonal low), is shown on Plate 2. Plate 3 shows lines of equal change in elevation of water in wells between June 1, 1973 and June 1, 1974. Plate 4 shows lines of equal depth to water as of September 1, 1974. These groundwater contours are drawn based on information from more than 200 wells.

The monthly fluctuation of water levels from 1969 to 1974 in the Santa Clara Valley, Coyote, and Llagas Basins are presented in Figure 2. These levels represent the weighted average of depths to water in approximately 35 representative wells which are monitored at the beginning of each month. All three groundwater basins have registered modest increases in water levels for 1974, continuing the trend of the previous year. The average water level in the Santa Clara Valley Basin rose 8 feet while water levels in the Coyote and Llagas Basins each gained an average of 7 feet.

In figures 3 and 4, the historical depths to water are shown in conjunction with rainfall and population, for the Santa Clara Valley and Llagas Groundwater Basins.

The dependence of water levels on seasonal rainfall is most graphically represented in the Llagas Groundwater Basin, which

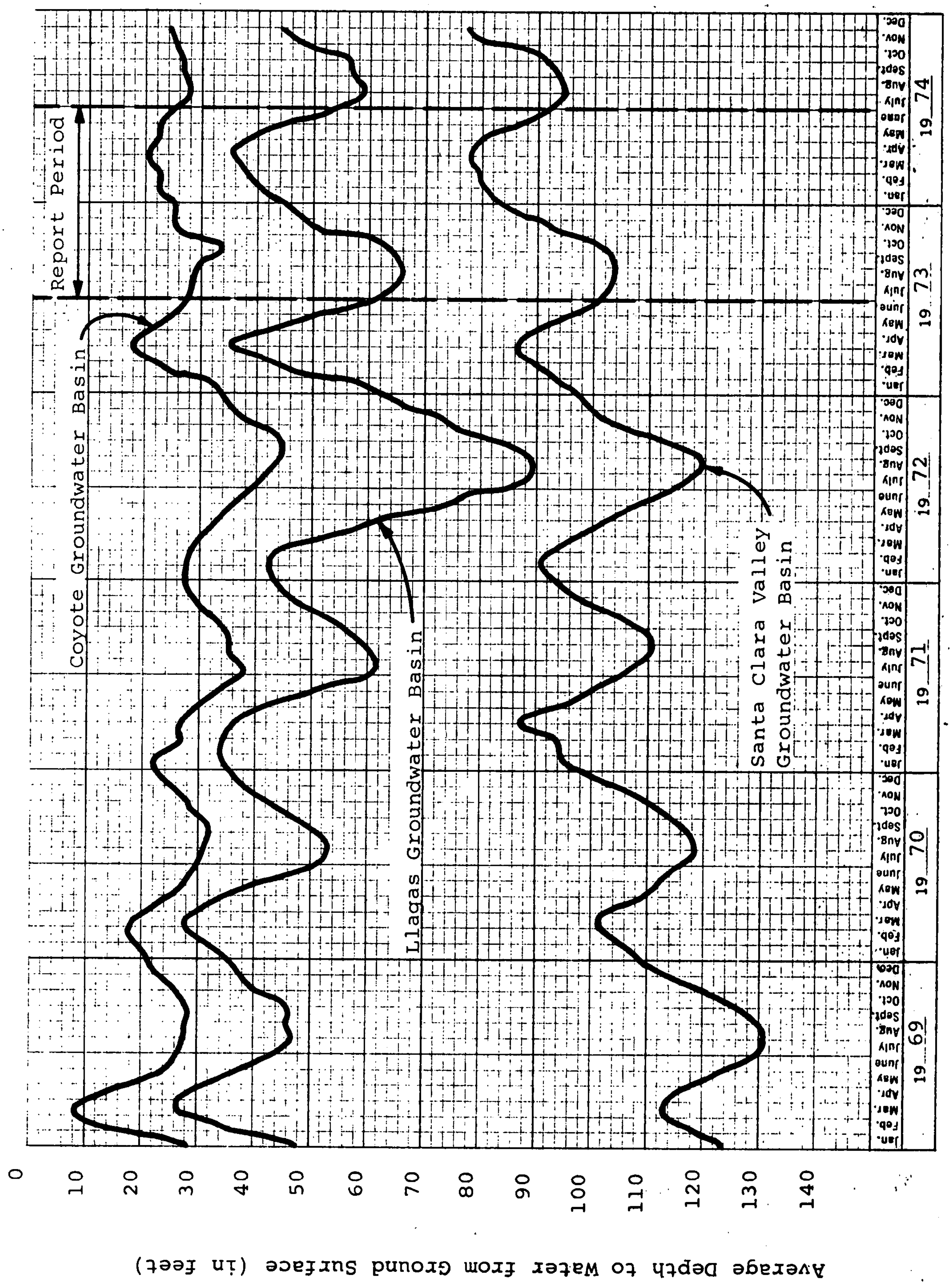


Figure 2. Fluctuations of Average Water Level

is much smaller and shallower than the Santa Clara Valley Groundwater Basin and has a lower storage capability per unit volume. Water levels are therefore much more responsive to the amount of rainfall in the Llagas Basin.

The north valley basin is less susceptible to large rapid fluctuations in water levels because of its size and because it is possible to carry-over from year to year quantities of water stored in the larger reservoirs to be used for groundwater recharge, and because of water imported from the South Bay Aqueduct a portion of which is also recharged.

The District is continuing its program of recharge of the groundwater basin with local and imported water. More than 100,000 acre-feet are recharged through District facilities annually.

FIGURE 3

SANTA CLARA VALLEY BASIN

LAND SUBSIDENCE–
Elevation of U.S. Coast
and Geodetic Survey
Benchmark P7 in
San Jose

POPULATION—
Total Population of
Santa Clara County

DEPTH TO WATER –
Average Depth to Water in
Feet, in Wells in Santa
Clara Valley Groundwater
Basin at End of
Irrigation Season

RAINFALL—
Total Seasonal Rainfall at
U.S. Weather Bureau
Station in San Jose

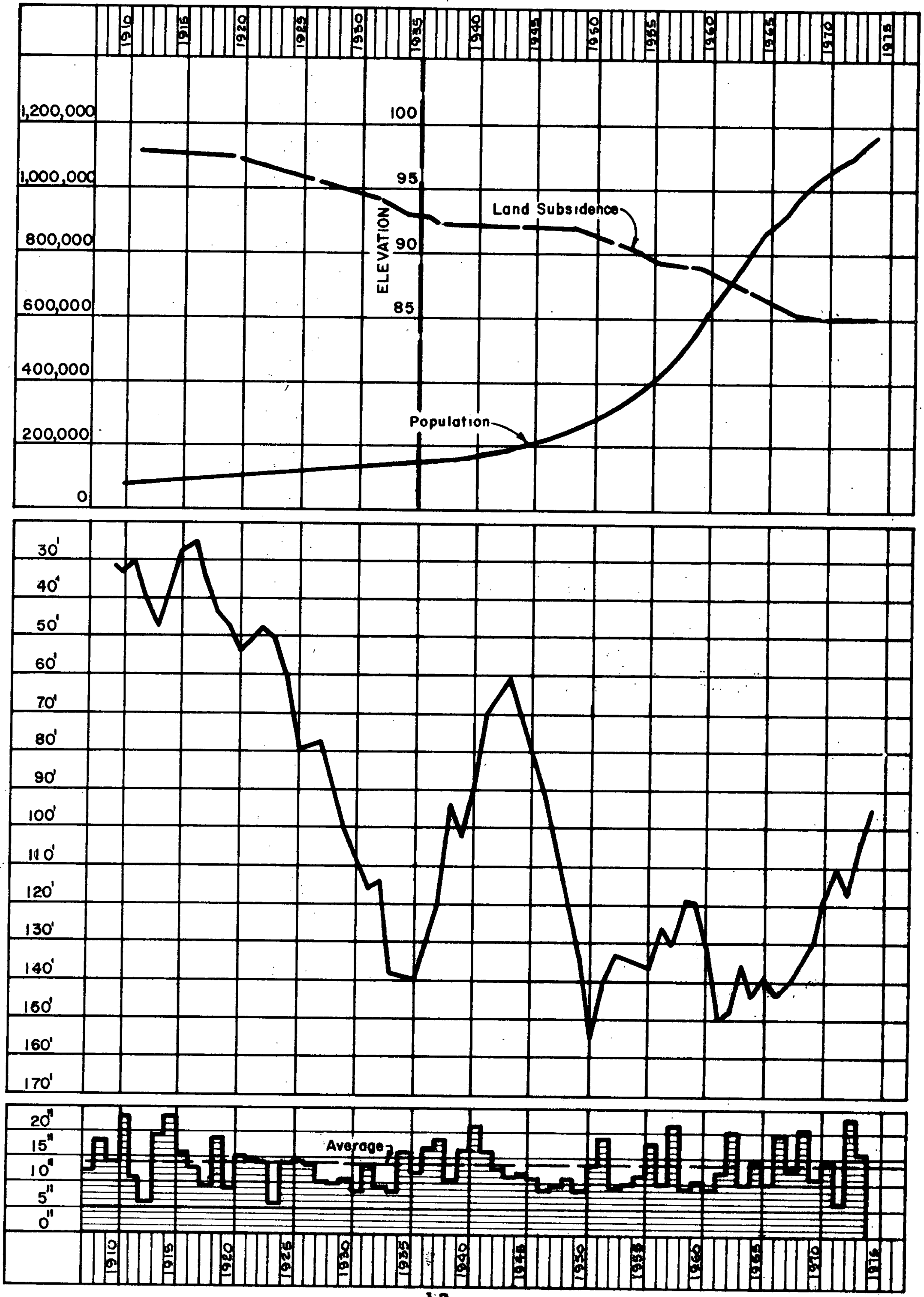

1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
100
95
90
85
ELEVATION
Land Subsidence
Population
30'
40'
50'
60'
70'
80'
90'
100'
110'
120'
130'
140'
160'
160'
170'
20"
15"
10"
5"
0"
Average
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975

Figure 3

FIGURE 4

LLAGAS BASIN

POPULATION—
Combined Populations of the Cities of Morgan Hill and Gilroy

DEPTH TO WATER—
Average Depth to Water in Feet in Wells in Llagas Groundwater Basin at End of Irrigation Season

RAINFALL—
Total Seasonal Rainfall at U.S. Weather Bureau Station in Gilroy

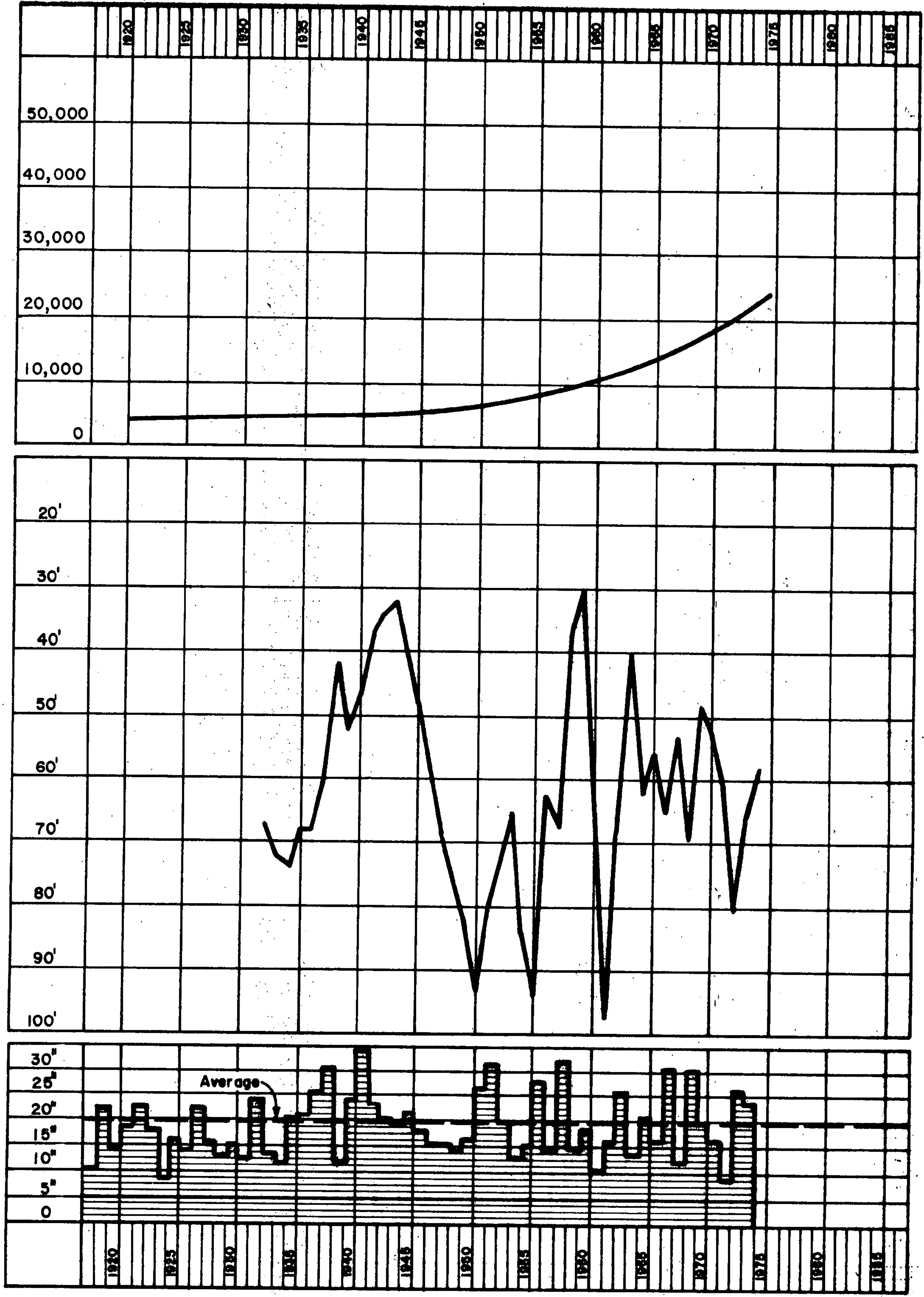
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
50,000
40,000
30,000
20,000
10,000
0
20'
30'
40'
50'
60'
70'
80'
90'
100'
30"
25"
20"
15"
10"
5"
0
Average

Figure 4

LAND SURFACE SUBSIDENCE

Subsidence of the land surface occurs when intensive groundwater pumping results in lowered artesian pressures in areas of groundwater confinement. This increases the effective overburden load on the clay materials within the confined aquifers causing them to compact, with consequential sinking of the land surface. This relationship between artesian head decline and land subsidence is graphically represented in Figure 3 which illustrates the historical occurrence of subsidence and the corresponding average depths to water.

Subsidence has cost Santa Clara County residences millions of dollars because of its direct effect on the design of and damage to flood control channels, levees, wells, sanitary sewer lines and other underground utilities.

Subsidence in the Santa Clara Valley is a condition carefully watched by the District, which annually makes a survey of ground elevation across the Valley floor along the southern end of San Francisco Bay to check for subsidence. The survey for 1974 showed no change in elevation of the Valley floor from that in 1973. Land surface subsidence has not occurred since 1969 because groundwater levels have risen above and have remained above the critical pressure elevation.

The District has been working toward the goal of obtaining water supplies adequate to stop the overdraft of groundwater and to raise the artesian head. As a result of increased imported water supplies, average rainfall, increased artificial recharge, and decreased pumping, the recovery of groundwater levels since 1966 has been dramatic. Continued control of subsidence is directly dependent on how well these levels can be maintained or improved.

IMPORTED WATER

The primary source of imported water for Santa Clara County is the South Bay Aqueduct. During the 1973-74 water year, 86,565 acre-feet of water was delivered into Santa Clara County through the South Bay Aqueduct. Of this total, 45,471 acre-feet was treated at the Rinconada Water Treatment Plant for delivery to consumers through retail water agencies. In addition, 553 acre-feet of raw water was delivered directly from District pipelines for use by individual contractors. The remaining 40,541 acre-feet was percolated through the District's recharge facilities into the underground.

The District's newest treatment plant, near Penitencia, began full-scale operation in July 1974. This 20-mgd plant, which is already operating at capacity, treats South Bay Aqueduct water and distributes it to the eastside area of the Santa Clara Valley via the recently completed East Pipeline.

The total South Bay Aqueduct import for the calendar year was 90,933 acre-feet. For the calendar year 1975, the District is obligated by contract to purchase its entitlement of 88,000 acre-feet from the State. In addition, 12,000 acre-feet of surplus water has been requested for a total expected delivery of 100,000 acre-feet.

A second source of imported water comes from the Sierras via the San Francisco Water Department's Hetch Hetchy Aqueduct. The Hetch Hetchy system has been supplying water to Santa Clara County since 1952. During the water year 1973-74, this system delivered 52,187 acre-feet directly to the water supply systems of the cities of Milpitas, San Jose, Sunnyvale, Mountain View, Palo Alto and to the Purissima Hills County Water District. The City of Santa Clara will begin receiving Hetch Hetchy water during the next fiscal year, 1974-75.

WATER SUPPLY

Rainfall is the source of all locally developed water supplies. The long-term precipitation at San Jose is illustrated in Figure 5 as the accumulated departure from the mean which denotes graphically the wet and dry periods of rainfall. The important feature in Figure 5 is the slope of the curve; particularly whether it is positive or negative. Each point is plotted as a difference from the long-term average; a wet year showing a positive difference and a dry or below normal rainfall year indicating a negative difference. If each difference is added to that of the previous year a trend of positive or negative increments becomes apparent. An upward trend would therefore indicate a period of years which have received above normal rainfall and a downward trend would be indicative of a drought period.

The accumulated departure from the mean is used to identify long-term wet and dry periods. Despite short-term fluctuations the long-term periods are evident in Figure 5.

Beginning in 1875 rainfall approximated the long-term average until 1890 when a series of unusually wet years began which continued through about 1916. The valley experienced abnormally low rainfall for several years following 1920 until 1935. It was during this drought period that valley residents became conscious of potential water problems and initiated a comprehensive water conservation program. The completion of the valley's first water supply reservoirs in 1936 coincided with a short interval of above-average rainfall. This enhanced the water supply picture and enabled groundwater levels, which had been declining, to recover. There is a remarkable correlation between the depth-to-water in Figure 3 and the accumulated departure from the average rainfall in Figure 5.

Between 1943 and 1962 another series of unusually dry years occurred. Since 1962 the valley has had rainfall slightly above the long-term average.

The demand for water and the amount of water available for supply are both very dependent on seasonal rainfall. In a below normal rainfall year when water supplies are low the demand for water increases, while in a wet year water demand drops. Shown on Figure 6 are the water demand projections for the period 1970 to 2020 and the recorded water use through 1974. The projections are based on the assumption of average seasonal rainfall.

North County water production figures for 1970-74 from all sources of supply are compiled in Table 1.

ACCUMULATED ANNUAL DEPARTURE IN INCHES
FROM THE 100-YEAR AVERAGE RAINFALL @ SAN JOSE

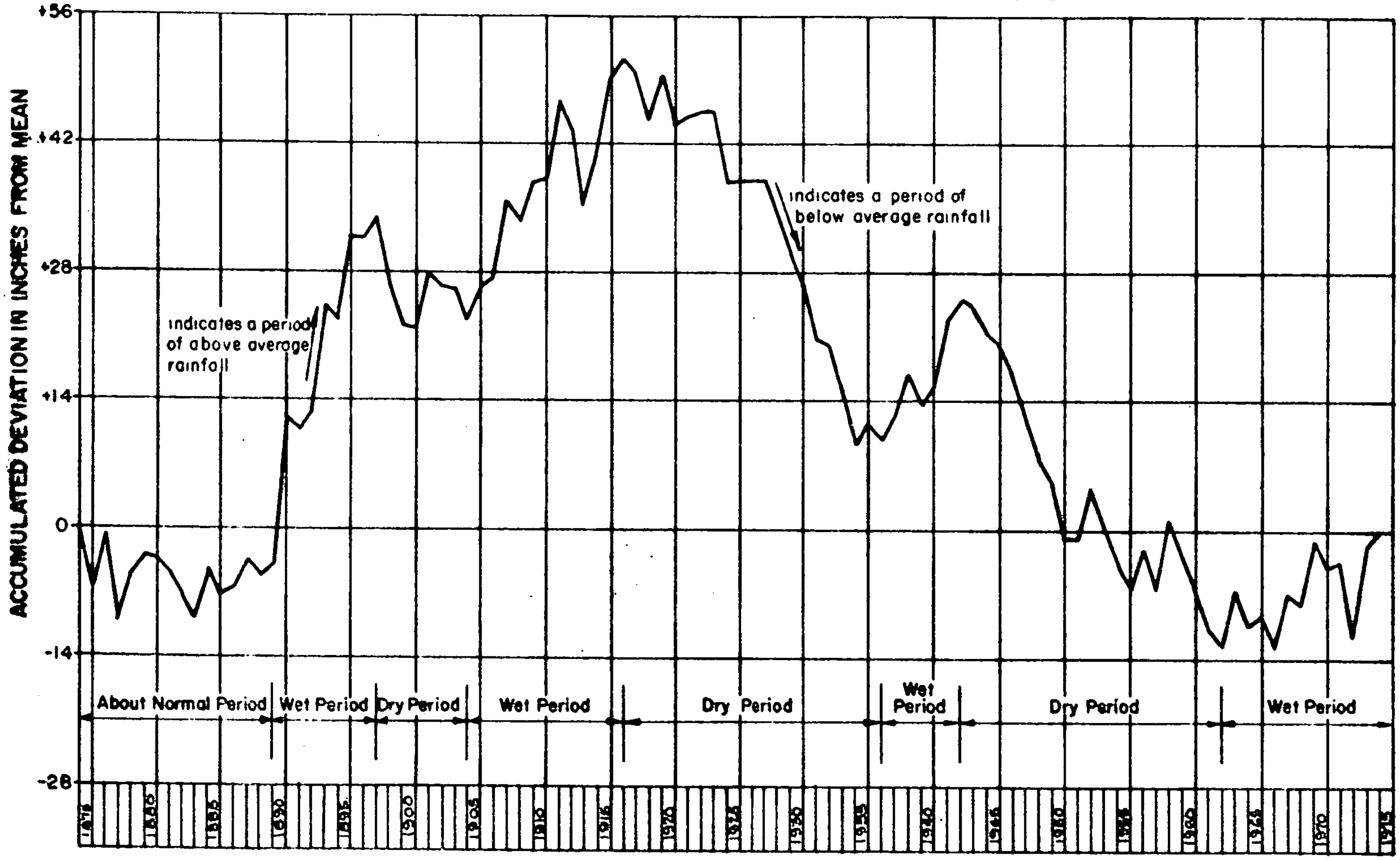


Figure 5

PROJECTED WATER DEMAND
AND
ACTUAL WATER PRODUCTION

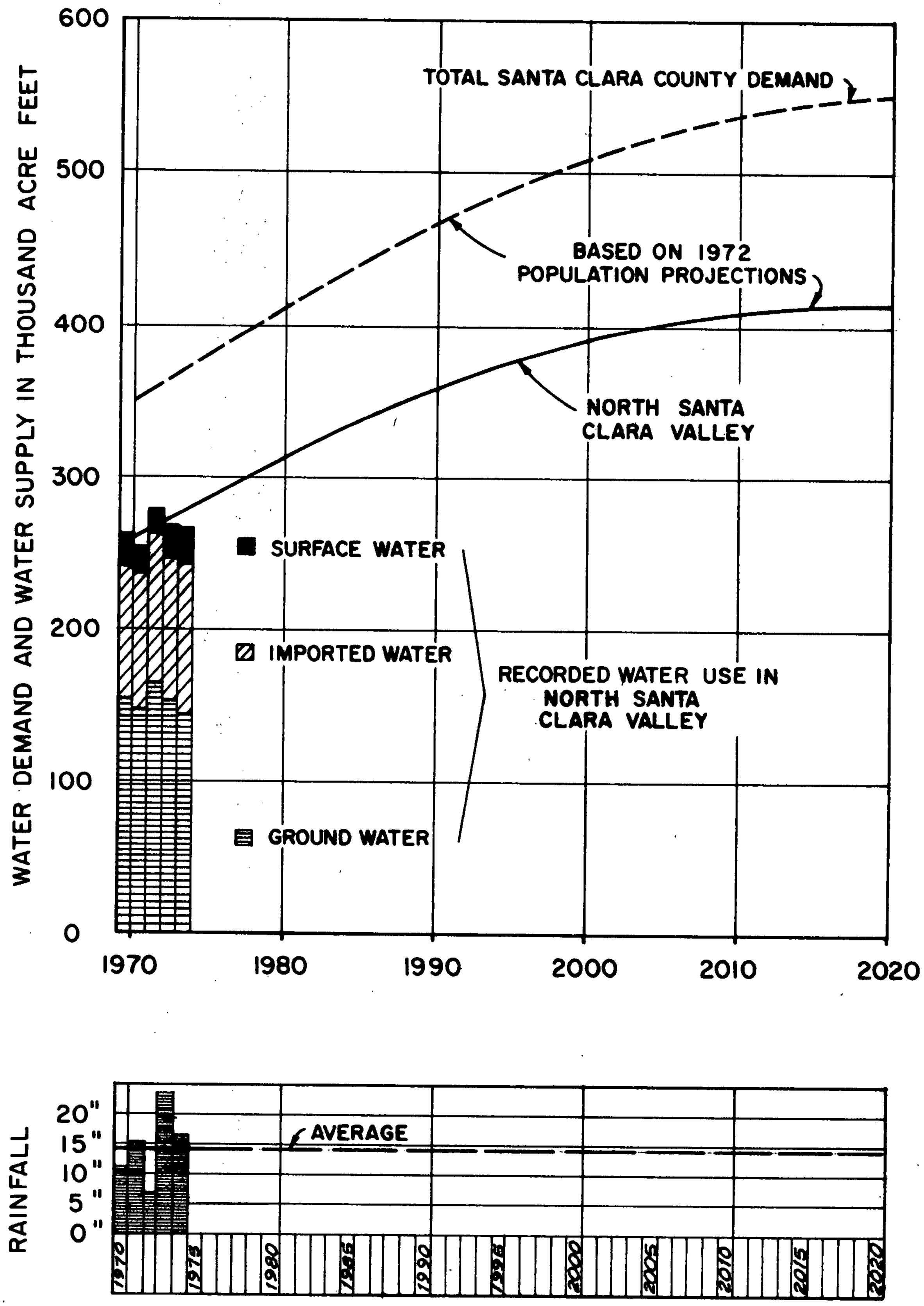


FIGURE 6

TABLE 1

WATER USE SUMMARY

Santa Clara Valley Groundwater Basin

(values in acre-feet)

Fiscal	Surface Water		Groundwater		SBA Import			SJWW	
						Local			
Year	Ag	Non-Ag	Ag	Non-Ag	Treated	Untreated	Hetch-Hetchy	Diversion	Total
69-70	4900	800	29300	125100	39200	500	48300	15800	263,900
70-71	4400	1100	23700	124300	44000	700	45200	12900	256,300
71-72	4800	1500	24000	142200	48800	800	49900	8800	280,700
72-73	4200	1600	17500	137800	45000	600	48900	14600	270,200
73-74	3000	1800	15900	129000	45500	600	52200	20800	268,700

Table 1

WATER QUALITY

Surface waters of the Santa Clara Valley are generally of excellent mineral quality, characterized by relatively low concentrations of dissolved solids, low percent sodium, and, with some exceptions in the Penitencia area, low boron content.

Since 1969, the District has been conducting a comprehensive water quality monitoring program of its conservation reservoirs. Water samples from each reservoir are collected every month and analyzed for physical, chemical and biological parameters. Evaluation of this data has shown that the water stored in Santa Clara County reservoirs continues to be of good quality.

Groundwater pumped from most of the existing wells in the County's basins is of good quality and, in general, meets all requirements for drinking water as set forth in the Standards of the U. S. Public Health Service. Groundwaters from properly constructed and protected wells, including many municipal well fields, are in some places used directly without chlorination.

Graphical representations of water quality parameter changes from selected wells are shown in Figures 7, 8, and 9. The locations of these wells are shown on Plate 1. Generally, the pumped water may be classified as moderately to extremely hard. Hardness of water is caused principally by compounds of calcium and magnesium.

Certain localized areas have yielded groundwater of inferior quality. Groundwater is subject to contamination in areas of intensive land use. From the surface the principal sources of contamination are septic tanks, surface ponding of contaminants and pollutants, and questionable waste disposal practices. From subsurface sources the threat of degradation comes from saltwater intrusion from San Francisco Bay (Plate 5) or from mineralized connate waters found at depth.

Another factor which may contribute to the degradation of the groundwater is the method of well construction. In addition to yielding groundwater of inferior quality, many improperly constructed wells function as channels for the movement of water between contaminated and uncontaminated aquifers. Improper methods of well construction and destruction, if allowed, could contribute to the deterioration of freshwater aquifers. Once an aquifer becomes contaminated or degraded, its restoration is extremely difficult and, in some cases, not economically feasible. Such a situation has already occurred in adjacent counties near San Francisco Bay. In order to help prevent this from happening in Santa Clara County, the District is working to establish well construction and destruction standards. The purpose of such standards is to protect and preserve the groundwater supply in aquifers for future uses.

To help in the management and protection of the quality of all the waters in the valley, the District has just initiated a two-year joint water quality program with the Department of

Water Resources and the U. S. Geological Survey, the objective of which is to develop a comprehensive plan for monitoring water quality of groundwater, streams, and reservoirs.

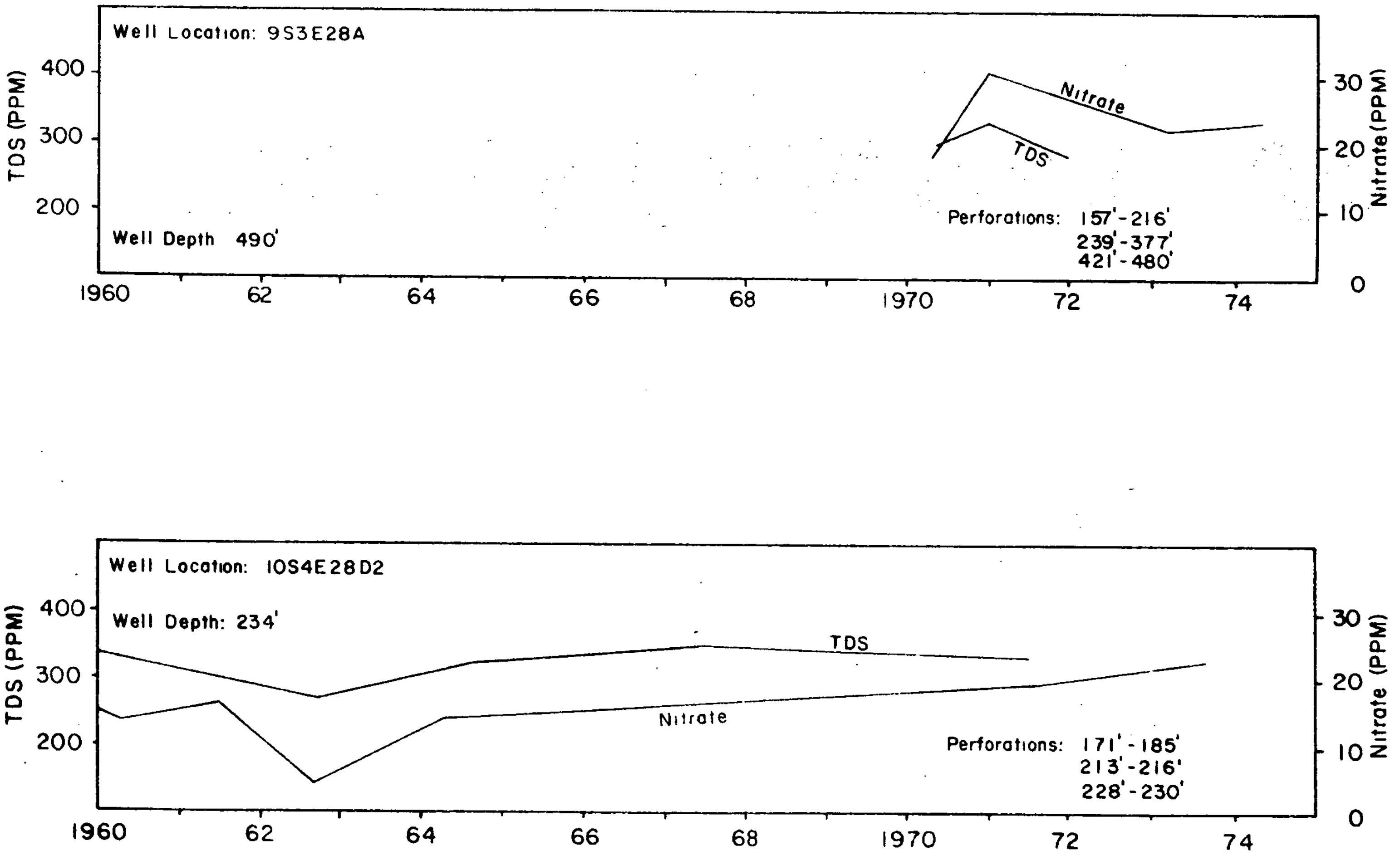


Figure 7. Temporal Variation of Nitrates and TDS-Llagas Basin

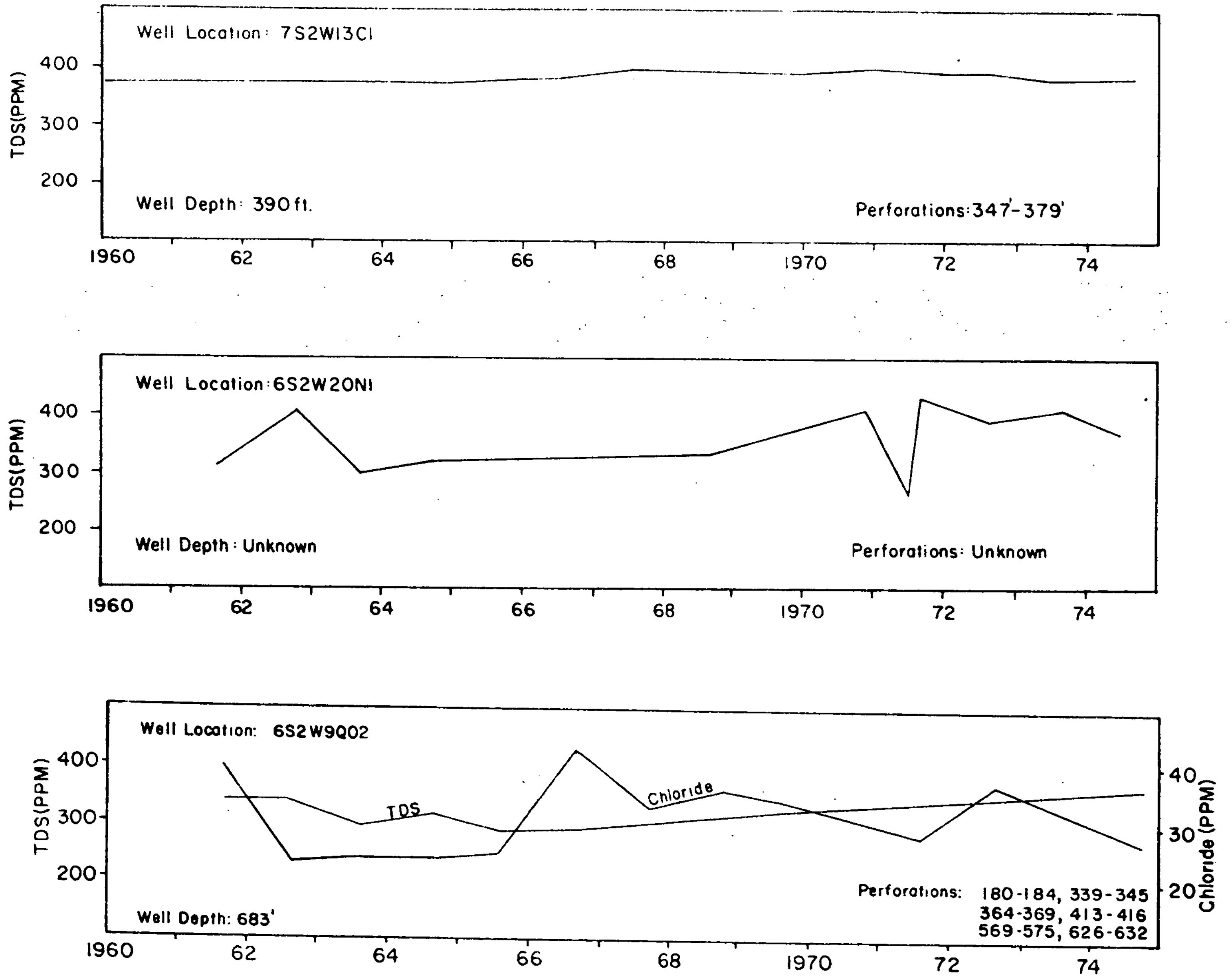


Figure 8. Temporal Variation of TDS and Chloride - Santa Clara Valley Groundwater Basin

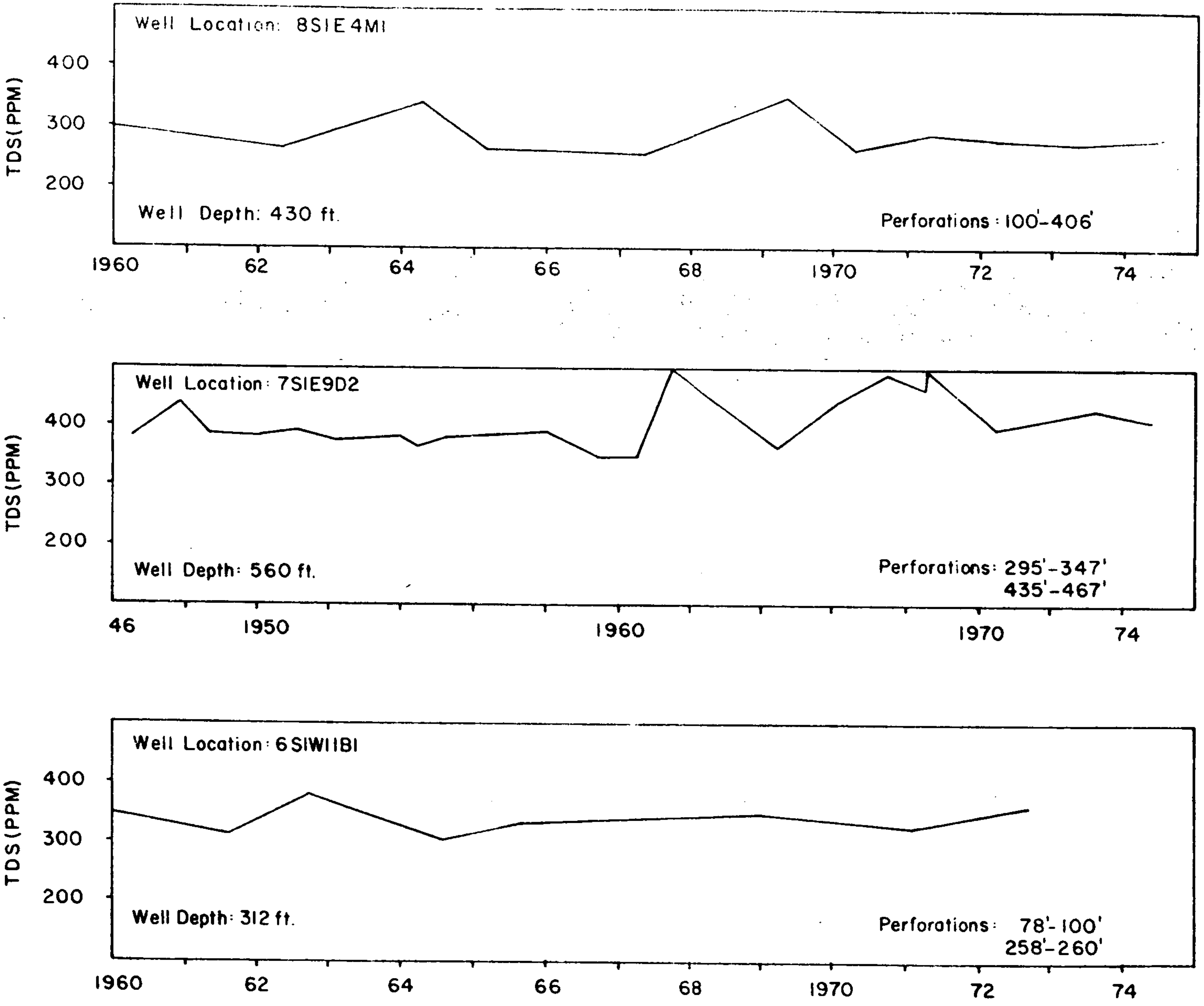


Figure 9. Temporal Variation of TDS - Santa Clara Valley Groundwater Basin

SALTWATER CONTAMINATION

The extent of saltwater contamination in the Santa Clara Valley Groundwater Basin has been monitored by the District for several years by sampling selected wells in the area around South San Francisco Bay. Water from these wells is analyzed for chloride content. The region affected by saltwater contamination is circumscribed by a line delineating the approximate limits of well water containing chloride concentrations greater than 100 mg/l (milligrams per liter) for the years 1949 through 1972 and is shown on Plate 5.

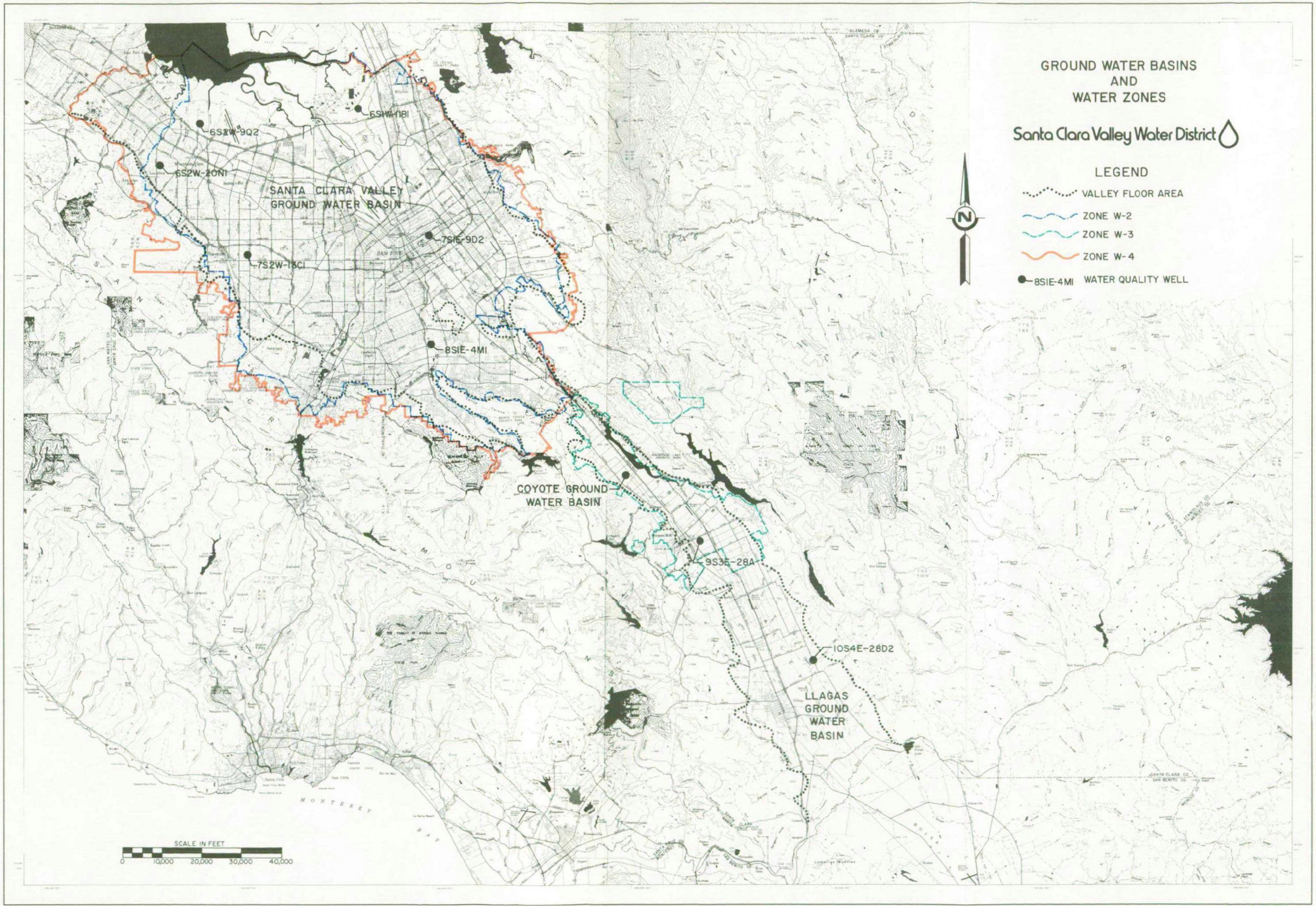
Generally, contaminated water is restricted to the shallow aquifers, less than 150 feet deep. The deeper aquifers still produce good water as they are protected by thick clay aquitards which have prevented saltwater from the Bay or from shallower aquifers from migrating to these deeper zones. In some cases, water may be gaining access to lower aquifers through gravel-packed wells, through wells perforated in both shallow and deep aquifers, or through wells improperly destroyed.

Since high chloride concentrations do not by themselves prove seawater intrusion, the District is continuing research to determine the exact mechanism causing the saltwater contamination.

Recognizing the necessity of control measures to reduce this intrusion and protect the aquifers, the District is undertaking the design of a system which will inject water into the shallow aquifers through wells. The injected water will set up a hydraulic barrier against intrusion for a very small portion of the groundwater basin in the vicinity of Palo Alto.

The water for injection will be furnished by a 3 MGD Water Reclamation Plant which will provide advanced treatment of effluent from the Palo Alto Regional Water Quality Control Plant.

A key part of the implementation of the reclaimed water well injection program will be the instituting of a comprehensive monitoring program with special emphasis upon public health aspects. The aquifer to be injected is not currently used for a public water supply. The project has the unique possibilities of helping to prevent contamination of groundwater of good quality, while at the same time providing the basis for possible utilization of reclaimed water to augment other sources of supply in order to satisfy future water needs.



GROUND WATER BASINS
AND
WATER ZONES
Santa Clara Valley Water District
LEGEND
VALLEY FLOOR AREA
ZONE W-2
ZONE W-3
ZONE W-4
8SIE-4MI WATER QUALITY WELL
N
SANTA CLARA VALLEY GROUND WATER BASIN
COYOTE GROUND WATER BASIN
LLAGAS GROUND WATER BASIN
6S2W-9Q2
6S1W-18I
6S2W-20N1
7S1E-9D2
7S2W-18C1
8S1E-4M1
9S3E-28A
10S4E-28D2
MONTEREY BAY
ALAMEDA CO
SANTA CLARA CO
SAN MATEO CO
SANTA CRUZ CO
SAN BENITO CO
SCALE IN FEET
0
10,000
20,000
30,000
40,000

PLATE I

LINES OF EQUAL GROUND WATER ELEVATION AS MEASURED IN WELLS SEPTEMBER 1, 1974

Santa Clara Valley Water District

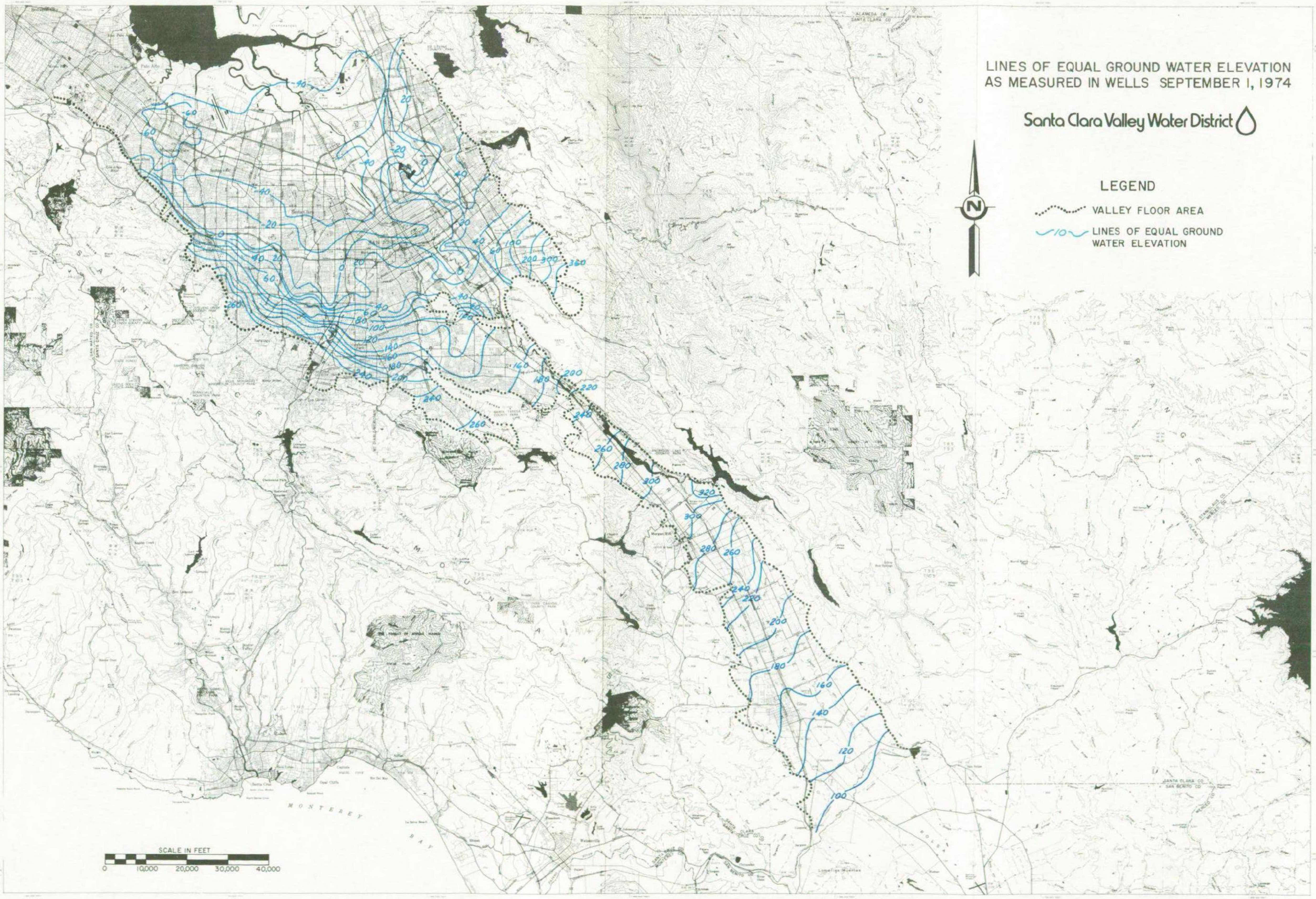
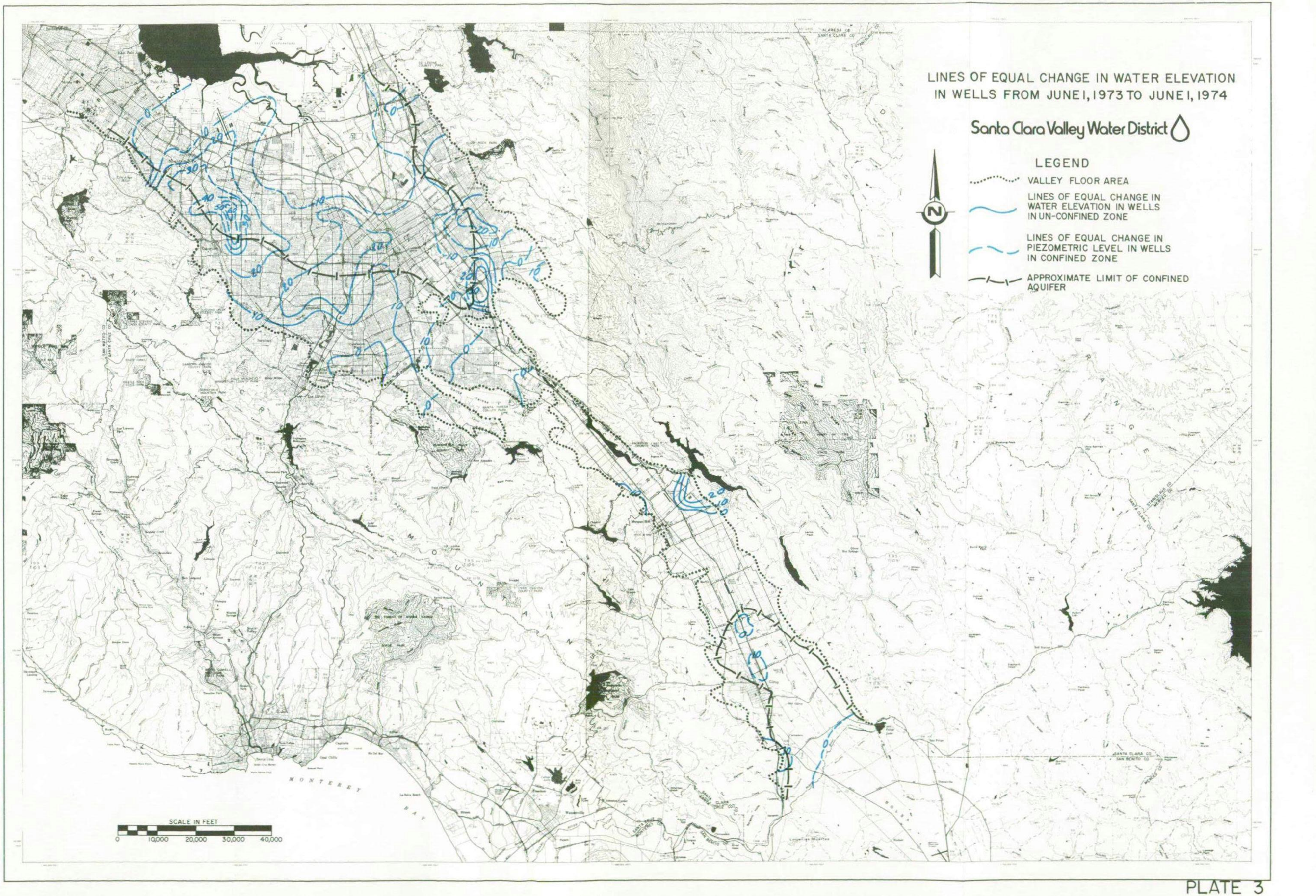


PLATE 2



LINES OF EQUAL CHANGE IN WATER ELEVATION IN WELLS FROM JUNE 1, 1973 TO JUNE 1, 1974

Santa Clara Valley Water District

PLATE 3

LINES OF EQUAL DEPTHS TO WATER AS MEASURED IN WELLS SEPTEMBER 1, 1974

Santa Clara Valley Water District

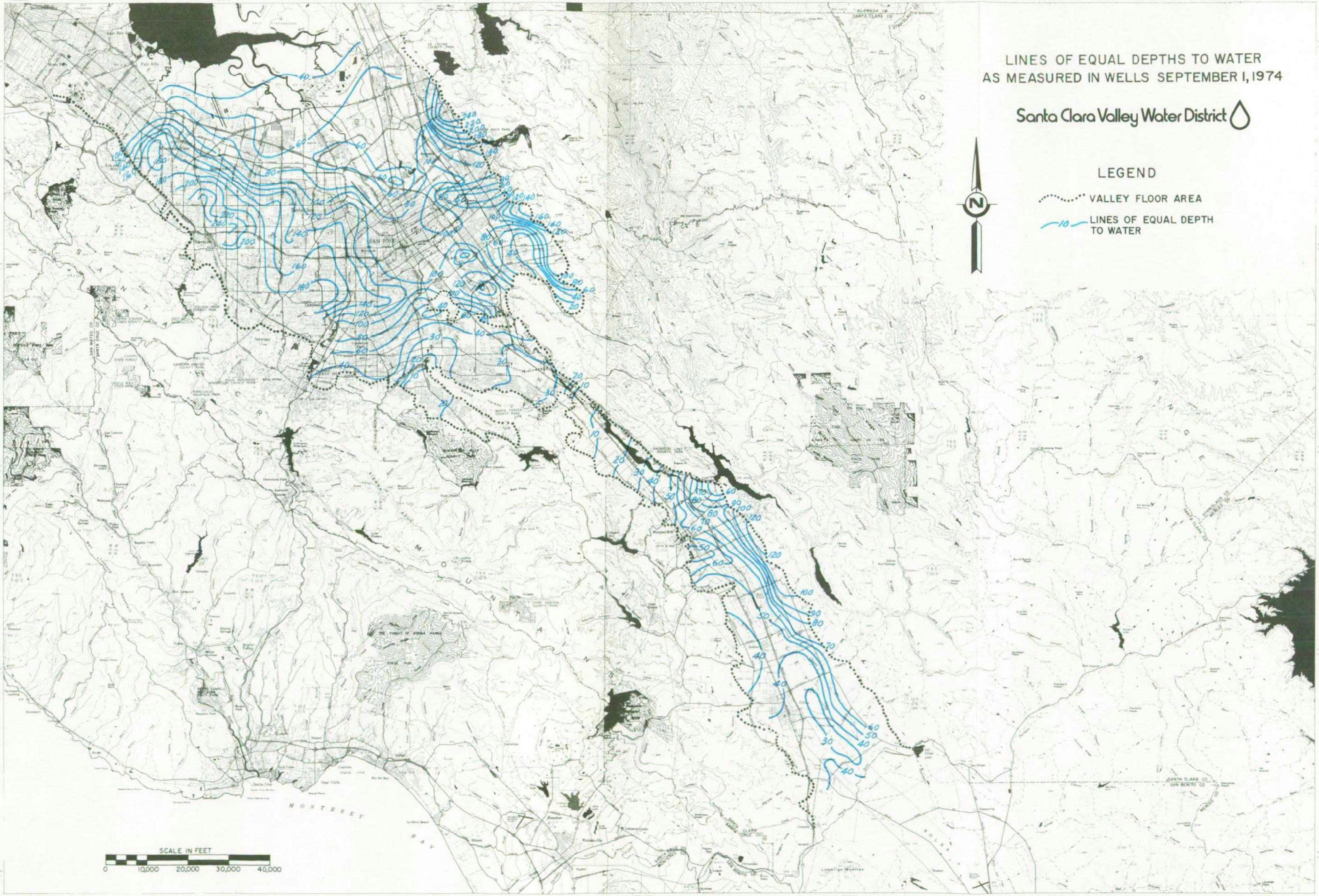


PLATE 4

PLATE 5

100 PPM CHLORIDE LINE

Santa Clara Valley Water District